

WHAT IS CLAIMED AS NEW AND IS DESIRED TO BE SECURED BY  
LETTERS PATENT OF THE UNITED STATES IS:

1 A fixing apparatus, comprising:

5 a heater having a line shape orthogonal to a direction  
in which a recording sheet carrying an unfixed toner image  
formed with toner in accordance with image information is  
transferred;

an endless belt configured to be rotated with an inner  
10 surface thereof sliding over a surface of said heater;

a pressure roller arranged at a position opposite to  
said heater relative to said endless belt, said pressure  
roller being held for rotation in contact with said endless  
belt under pressure to form a nip therebetween; and

15 a heater controller configured to energize said heater  
in accordance with said image information,

wherein, when said recording sheet is brought to said  
nip with said unfixed toner image facing said endless belt,  
said pressure roller applies pressure to said recording sheet  
20 against said endless belt so that said unfixed toner image is  
fixed on said recording sheet with heat by said heater as  
said recording sheet is transferred by movement of said  
endless belt and said pressure roller.

25 2. A fixing apparatus as defined in Claim 1, wherein

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said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10<sup>13</sup> [c poise] under a temperature above said  
5 softening or melting point.

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3. A fixing apparatus as defined in Claim 1, wherein said heater includes at least two parallel heating elements, each of which has a line shape orthogonal to said direction  
10 in which said recording sheet is transferred.

4. A fixing apparatus as defined in Claim 3, wherein said heater controller alternately energizes said at least two parallel heating elements with alternating pulses.  
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5. A fixing apparatus as defined in Claim 3, wherein said at least two parallel heating elements are distant from each other by 10 mm or less.

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20 6. A fixing apparatus as defined in Claim 2, wherein each of said at least two parallel heating elements has a width in a range between 0.01 mm and 5 mm.

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25 7. A fixing apparatus as defined in Claim 1, wherein said heater includes a plurality of heating elements arranged

in line in a direction orthogonal to said direction in which  
said recording sheet is transferred.

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8. A fixing apparatus as defined in Claim 7, wherein  
5 each of said plurality of heating elements includes a thermal  
head.

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9. A fixing apparatus as defined in Claim 6, wherein  
said heater controller selectively energizes said plurality  
10 of heating elements.

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Sub 2

10. A fixing apparatus as defined in Claim 1, further  
comprising a cooling mechanism configured to cool said toner  
image after said toner image is fixed with heat by said  
15 heater on said recording sheet.

11. A fixing apparatus as defined in Claim 1, further  
comprising a guide roller arranged at a position downstream  
from said heater in said direction in which said recording  
20 sheet is transferred, said guide roller being configured to  
support said endless belt and to serve as a cooling mechanism  
configured to cool said toner image after said toner image is  
fixed with heat by said heater on said recording sheet.

25 12. A fixing apparatus as defined in Claim 1, further

comprising a mechanism configured to cause said endless belt to tightly hold said toner image and said recording sheet together until said toner image is fixed on said recording sheet after said toner image is subjected to the heat of said heater.

13. A fixing apparatus as defined in Claim 1, wherein said heater controller stops energizing said heater during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

14. A fixing apparatus as defined in Claim 1, wherein said heater controller energizes said heater during a time when a region of said toner image in said recording sheet is brought close to said heater.

15. A fixing apparatus as defined in Claim 1, wherein said heater controller energizes said heater with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

16. A fixing apparatus, comprising:

heating means for heating an unfixed toner image formed with toner on a recording sheet in accordance with image

information, said heating means having a line shape  
orthogonal to a direction in which said recording sheet is  
transferred;

endless belt means for being rotated with an inner  
5 surface thereof sliding over a surface of said heating means;

pressure roller means for being held for rotation in  
contact with said endless belt means under pressure to form a  
nip therebetween, said pressure roller means being arranged  
at a position opposite to said heating means relative to said  
10 endless belt means; and

heater controlling means for energizing said heating  
means in accordance with said image information,

wherein, when said recording sheet is brought to said  
nip with said unfixed toner image facing said endless belt  
15 means, said pressure roller means applies pressure to said  
recording sheet against said endless belt means so that said  
unfixed toner image is fixed on said recording sheet with  
heat by said heating means as said recording sheet is  
transferred by movement of said endless belt means and said  
20 pressure roller means.

17. A fixing apparatus as defined in Claim 16,  
wherein said toner includes a resin as a main adhesive agent  
and has properties of a softening or melting point in a range  
25 between 50°C and 160 °C and a viscosity in a range between 10

32 [c poise] and  $10^{13}$  [c poise] under a temperature above said softening or melting point.

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18. A fixing apparatus as defined in Claim 16,  
5 wherein said heating means includes at least two parallel heating elements, each of which has a line shape orthogonal to said direction in which said recording sheet is transferred.

10 19. A fixing apparatus as defined in Claim 18,  
wherein said heater controlling means alternately energizes said at least two parallel heating elements with alternating pulses.

15 20. A fixing apparatus as defined in Claim 18,  
wherein said at least two parallel heating elements are distant from each other by 10 mm or less.

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21. A fixing apparatus as defined in Claim 17,  
20 wherein each of said at least <sup>a</sup>two parallel heating elements has a width in a range between 0.01 mm and 5 mm.

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22. A fixing apparatus as defined in Claim 16,  
wherein said heating means includes a plurality of heating  
25 elements arranged in line in a direction orthogonal to said

direction in which said recording sheet is transferred.

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23. A fixing apparatus as defined in Claim 22,  
wherein each of said plurality of heating elements includes a  
5 thermal head.

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24. A fixing apparatus as defined in Claim 21,  
wherein said heater controlling means selectively energizes  
said plurality of heating elements.

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25. A fixing apparatus as defined in Claim 16,  
further comprising cooling means for cooling said toner image  
after said toner image is fixed with heat by said heating  
means on said recording sheet.

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26. A fixing apparatus as defined in f Claim 16,  
further comprising guide roller means for supporting said  
endless belt means and serving as cooling means for cooling  
said toner image after said toner image is fixed with heat by  
20 said heating means on said recording sheet, said guide roller  
being arranged at a position downstream from said heating  
means in said direction in which said recording sheet is  
transferred.

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27. A fixing apparatus as defined in Claim 16,

further comprising means for causing said endless belt means to tightly hold said toner image and said recording sheet together until said toner image is fixed on said recording sheet after said toner image is subjected to the heat of said heating means.

28. A fixing apparatus as defined in Claim 16, wherein said heater controlling means stops energizing said heating means during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

29. A fixing apparatus as defined in Claim 16, wherein said heater controlling means energizes said heating means during a time when a region of said toner image in said recording sheet is brought close to said heating means.

30. A fixing apparatus as defined in Claim 16, wherein said heater controlling means energizes said heating means with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

31. A fixing method of image forming, comprising the



steps of:

forming a nip between an endless belt and a pressure roller which are held for rotation in contact with each other under pressure;

5 providing a heater at position inside said endless belt, in contact with said endless belt, and opposite to said pressure roller relative to said endless belt, said heater

having a line shape orthogonal to a direction in which a recording sheet having an unfixed toner image formed with

10 toner in accordance with image information is transferred;

rotating said endless belt and said pressure roller, said endless belt sliding over a surface of said heater by rotation;

transferring said recording sheet to said nip, said 15 recording sheet being in an orientation in which said toner image faces said endless belt; and

energizing said heater in accordance with said image information when said toner image is brought to said heater.

20 32. A fixing method as defined in Claim 31, wherein said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10<sup>13</sup> [c poise] under a temperature above said 25 softening or melting point.

33. A fixing method as defined in Claim 31, wherein  
said heater includes at least two parallel heating elements,  
each of which has a line shape orthogonal to said direction  
in which said recording sheet is transferred.

34. A fixing method as defined in Claim 33, wherein  
said energizing step alternately energizes said at least two  
parallel heating elements with alternating pulses.

35. A fixing method as defined in Claim 33, wherein  
said at least two parallel heating elements are distant from  
each other by 10 mm or less.

36. A fixing apparatus as defined in Claim 32,  
wherein each of said at least two parallel heating elements  
has a width in a range between 0.01 mm and 5 mm.

37. A fixing method as defined in Claim 31, wherein  
said heater includes a plurality of heating elements arranged  
in line in a direction orthogonal to said direction in which  
said recording sheet is transferred.

38. A fixing method as defined in Claim 37, wherein  
each of said plurality of heating elements includes a thermal

head.

39. A fixing method as defined in Claim 36, wherein  
said energizing step selectively energizes said plurality of  
5 heating elements.

40. A fixing method as defined in Claim 31, further  
comprising a cooling step for cooling said toner image after  
said toner image is fixed with heat by said heating step on  
10 said recording sheet.

41. A fixing method as defined in Claim 31, further  
comprising a providing step for providing a guide roller for  
supporting said endless belt and for serving as a cooling  
15 member for cooling said toner image after said toner image is  
fixed with heat by said heating step on said recording sheet,  
said guide roller being arranged at a position downstream  
from said heater in said direction in which said recording  
sheet is transferred.

42. A fixing method as defined in Claim 31, further  
comprising a providing step of providing a member for causing  
said endless belt to tightly hold said toner image and said  
recording sheet together until said toner image is fixed on  
25 said recording sheet after said toner image is subjected to

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46. An image forming apparatus, comprising:

a heater having a line shape orthogonal to a direction  
 such said recording sheet carrying an unfixed toner image  
 and by said image forming mechanism is transferred;

an endless belt configured to be rotated with an inner surface thereof sliding over a surface of said heater;

5 a pressure roller arranged at a position opposite to said heater relative to said endless belt, said pressure roller being held for rotation in contact with said endless belt under pressure to form a nip therebetween; and

a heater controller configured to energize said heater in accordance with said image information,

10 wherein, when said recording sheet is brought to said nip with said unfixed toner image facing said endless belt, said pressure roller applies pressure to said recording sheet against said endless belt so that said unfixed toner image is fixed on said recording sheet with heat by said heater as said recording sheet is transferred by movement of said  
15 endless belt and said pressure roller.

47. An image forming apparatus as defined in Claim 45, wherein said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range  
20 between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10<sup>13</sup> [c poise] under a temperature above said softening or melting point.

48. An image forming apparatus as defined in Claim 45,  
25 wherein said heater includes at least two parallel heating

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elements, each of which has a line shape orthogonal to said  
direction in which said recording sheet is transferred.

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49. An image forming apparatus as defined in Claim 48,  
5 wherein said heater controller alternately energizes said at  
least two parallel heating elements with alternating pulses.

50. An image forming apparatus as defined in Claim 48,  
wherein said at least two parallel heating elements are  
10 distant from each other by 10 mm or less.

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51. An image forming apparatus as defined in Claim 47,  
wherein each of said at least two parallel heating elements  
has a width in a range between 0.01 mm and 5 mm.

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52. An image forming apparatus as defined in Claim 46,  
wherein said heater includes a plurality of heating elements  
arranged in line in a direction orthogonal to said direction  
in which said recording sheet is transferred.

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53. An image forming apparatus as defined in Claim 52,  
wherein each of said plurality of heating elements includes a  
thermal head.

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54. An image forming apparatus as defined in Claim 51,

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wherein said heater controller selectively energizes said plurality of heating elements. /a

55. An image forming apparatus as defined in Claim 46,  
5 further comprising a cooling mechanism configured to cool  
said toner image after said toner image is fixed with heat by  
said heater on said recording sheet.

56. An image forming apparatus as defined in Claim 46,  
10 further comprising a guide roller arranged at a position  
downstream from said heater in said direction in which said  
recording sheet is transferred, said guide roller being  
configured to support said endless belt and to serve as a  
cooling mechanism configured to cool said toner image after  
15 said toner image is fixed with heat by said heater on said  
recording sheet.

57. An image forming apparatus as defined in Claim 46,  
further comprising a mechanism configured to cause said  
20 endless belt to tightly hold said toner image and said  
recording sheet together until said toner image is fixed on  
said recording sheet after said toner image is subjected to  
the heat of said heater.

25 58. An image forming apparatus as defined in Claim 46,

wherein said heater controller stops energizing said heater during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

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59. An image forming apparatus as defined in Claim 46, wherein said heater controller energizes said heater during a time when a region of said toner image in said recording sheet is brought close to said heater.

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60. An image forming apparatus as defined in Claim 46, wherein said heater controller energizes said heater with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

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61. An image forming apparatus, comprising:

image forming means for forming a toner image with toner on a recording sheet in accordance with image information;

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heating means for heating an unfixed toner image formed with toner on a recording sheet in accordance with image information, said heating means having a line shape orthogonal to a direction in which said recording sheet is

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transferred;

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endless belt means for being rotated with an inner surface thereof sliding over a surface of said heating means;

pressure roller means for being held for rotation in contact with said endless belt means under pressure to form a nip therebetween, said pressure roller means being arranged at a position opposite to said heating means relative to said endless belt means; and

heater controlling means for energizing said heating means in accordance with said image information,

wherein, when said recording sheet is brought to said nip with said unfixed toner image facing said endless belt means, said pressure roller means applies pressure to said recording sheet against said endless belt means so that said unfixed toner image is fixed on said recording sheet with heat by said heating means as said recording sheet is transferred by movement of said endless belt means and said pressure roller means.

62. An image forming apparatus as defined in Claim 61, wherein said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10<sup>13</sup> [c poise] under a temperature above said softening or melting point.

63. An image forming apparatus as defined in Claim 61,  
wherein said heating means includes at least two parallel  
heating elements, each of which has a line shape orthogonal  
to said direction in which said recording sheet is  
transferred.

64. An image forming apparatus as defined in Claim 63,  
wherein said heater controlling means alternately energizes  
said at least two parallel heating elements with alternating  
pulses.

65. An image forming apparatus as defined in Claim 63,  
wherein said at least two parallel heating elements are  
distant from each other by 10 mm or less.

66. An image forming apparatus as defined in Claim 62,  
wherein each of said at least two parallel heating elements  
has a width in a range between 0.01 mm and 5 mm.

67. An image forming apparatus as defined in Claim 61,  
wherein said heating means includes a plurality of heating  
elements arranged in line in a direction orthogonal to said  
direction in which said recording sheet is transferred.

68. An image forming apparatus as defined in Claim 67,

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wherein each of said plurality of heating elements includes a thermal head.

69. An image forming apparatus as defined in Claim 66,  
5 wherein said heater controlling means selectively energizes said plurality of heating elements.

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70. An image forming apparatus as defined in Claim 61,  
further comprising cooling means for cooling said toner image  
10 after said toner image is fixed with heat by said heating means on said recording sheet.

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71. An image forming apparatus as defined in Claim 61,  
further comprising guide roller means for supporting said  
15 endless belt means and serving as cooling means for cooling said toner image after said toner image is fixed with heat by said heating means on said recording sheet, said guide roller being arranged at a position downstream from said heating means in said direction in which said recording sheet is  
20 transferred.

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72. An image forming apparatus as defined in Claim 61,  
further comprising means for causing said endless belt means  
to tightly hold said toner image and said recording sheet  
25 together until said toner image is fixed on said recording

sheet after said toner image is subjected to the heat of said heating means.

73. An image forming apparatus as defined in Claim 61,  
5 wherein said heater controlling means stops energizing said heating means during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

74. An image forming apparatus as defined in Claim 61,  
10 wherein said heater controlling means energizes said heating means during a time when a region of said toner image in said recording sheet is brought close to said heating means.

75. An image forming apparatus as defined in Claim 61,  
15 wherein said heater controlling means energizes said heating means with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said  
20 heating means.